

REDESIGNING THE INCENTIVE SPIROMETER

ACCESSIBILITY OF MEDICAL DEVICES FOR DISABLED ASIAN AMERICANS

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By

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SOCIOTECHNICAL SYNTHESIS

Medical device development prioritizes general safety and efficacy, often neglecting to take into account the diversity of patients and their experiences with a device. As such, the technical project focuses on improving patient adherence to using a medical device by redesigning and gamifying the device to create a more engaging experience for the patient. It is crucial that medical device design considers both technical and human factors. The science, technology, and society (STS) Research Paper frames medical device technology from a sociotechnical standpoint by analyzing the extent of medical device accessibility for disabled Asian Americans. The technical project and STS Research paper are both tightly coupled, as the STS topic describes inherent problems that arise from the technical project.

The technical report summarizes the prototyping process of a redesigned incentive spirometer, a medical device that prevents postoperative pulmonary complications. Despite how crucial the device is in recovery, doctors report low patient adherence to using the device. The proposed, gamified design incorporates a Ferris wheel component that spins during use, picking up plastic balls to deposit in buckets within the device. The spirometer was modeled using Autodesk Fusion, a 3D design software, and was 3D printed with printing filaments. This patient-centered design process can guide and set a precedence for a more human-centered approach to medical device design.

Several components of the incentive spirometer were successfully printed, including gears and a gas flow indicator. Although drop tests proved the integrity of the components, the gas flow indicator failed an inhalation test to check its functionality. Furthermore, a lack of availability and accuracy of 3D printers resulted in delays during the prototyping process. Future work will complete the model and clinically compare its effect on patient adherence against a

standard incentive spirometer.

The STS Research Paper further emphasizes the importance of considering human factors in medical device design by specifically studying the extent to which medical devices are accessible for disabled Asian Americans. The paper revealed that disabled Asian Americans face unique struggles with medical device accessibility. Due to the lack of research in this topic, the overall approach to the paper broke down the topic by studying both the experiences of disabled individuals and Asian Americans as well as factors influencing medical device accessibility. Law, Callon, and Latour's Actor Network Theory was used to synthesize information gathered. Sources such as personal accounts, public health studies, and Asian American research and dialogues revealed nuanced experiences of disabled Asian Americans with medical devices.

Historically, individuals with disabilities faced discrimination and efforts to exclude them from society. Despite efforts advocating for disabled people's rights, there persist inaccessible activities and negative perceptions of disability. Likewise, in healthcare, Asian Americans face stereotypes and generalizations as a result of factors out of their control. Asian Americans also do not seek preventive health treatment, resulting in inadequate healthcare. Regarding medical device accessibility, organizational and cultural aspects prevent a collective movement toward addressing the issue. Considering relationships between each component of the larger issue led to suggestions in future solutions. Approaches must individually address problems for disabled individuals, Asian Americans, and improving medical device accessibility.

When designing any technology, it is necessary to consider the diversity and needs of end users. This is especially urgent in the medical device industry, where devices are often determining factors between life and death. Technological design has both technical and social implications for end users.

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PROSPECTUS

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